FURTHER STUDIES ON THE RELATIONSHIP OF THE VIRUSES OF ROCKY MOUNTAIN SPOTTED FEVER AND SAO PAULO EXANTHEMATIC TYPHUS[1]

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In a recent paper [2] the writers presented data which showed that sera of guinea pigs and rabbits recently recovered from Sao Paulo exanthematic typhus had a high degree of protective value against Rocky Mountain spotted fever serum-virus. These results suggested a close relationship between the two viruses. Other studies correlated thereto have since been made, in which a strain of the Sao Paulo disease was used that had been established in guinea pigs from infected ticks of the species *Amblyomma cajennense*. These had been very kindly forwarded to us by Dr. J. L. Monteiro, of the Instituto Butantan, Sao Paulo, Brazil. Part of these experiments are reported herein as follows: (1) Tests to determine the protective value of sera of animals recovered from Rocky Mountain spotted fever against Sao Paulo exanthematic typhus serum-virus and (2) cross-immunity tests using guinea pigs recovered from Rocky Mountain spotted fever and Sao Paulo exanthematic typhus citrated whole-blood virus. The resultant data afford further evidence of the close relationship of the two diseases.

MATERIALS AND TECHNIQUE

Protection tests.—The procedure followed in testing the protective value of Rocky Mountain spotted fever convalescent sera against Sao Paulo serum-virus was the same as that employed in making similar tests in the opposite direction.

Four samples of Rocky Mountain spotted fever convalescent sera were employed. No. 1 was taken the fourth day, no. 2 the fifth day, no. 3 the sixth day, and no. 4 the eighth day after the last day of

fever. The first three samples were pooled sera from several guinea pigs. From each serum duplicate series of three mixtures with Sao Paulo guinea pig serum-virus no. 291 were prepared. The mixtures of each series all contained 0.5 cc of the test serum and 0.1 cc, 0.25 cc, and 0.5 cc, respectively, of the serum-virus. These six mixtures, after standing one half hour at room temperature, were injected intraperitoneally into separate guinea pigs. Sao Paulo serum-virus control guinea pigs were injected intraperitoneally as follows: six received 0.1 cc each, six 0.25 cc, and six 0.5 cc. This serum-virus was from heart blood drawn from 2-passage virus animals on the second day of fever, and was shown infectious to a one two-hundred-and-fiftieth part of a cubic centimeter.

The test guinea pigs that remained afebrile were observed for a period of 15 days; those that showed fever were observed for a longer period, if necessary. The serum-virus controls were observed until death occurred or recovery was assured.

Only male guinea pigs were used for both this experiment and the one described in the following:

Cross-immunity tests.—Twelve guinea pigs recovered from Rocky Mountain spotted fever for a period of approximately 8 months were used. Six were injected intraperitoneally with 1 cc of Sao Paulo whole-blood passage virus no. 288. The other six each received 1 cc of similar Rocky Mountain spotted fever passage virus no. 287. Each of these lots of virus contained one-fifth part of physiological salt solution with 2 percent sodium citrate. These animals were observed over a period of 13 days.

As virus control animals, two guinea pigs each received 1 cc of the citrated Sao Paulo virus and four received 1 cc of the citrated spotted fever virus.

Rocky Mountain spotted fever virus no. 287 consisted of the pooled citrated heart blood from passage guinea pigs of three highly virulent strains, all of which cause the death of over 90 percent of inoculated guinea pigs.

RESULTS

Protection tests.—Protocols of the protection tests are shown graphically in chart 1. All four samples of convalescent Rocky Mountain spotted fever guinea pig serum showed high protective value. The 0.5 cc units of 3 of the sera (nos. 1, 3, and 4) fully protected the test animals against all 3 amounts of the Sao Paulo virus, and serum no. 2 fully protected those animals that received mixtures containing 0.1 cc and 0.25 cc of serum-virus. One of the animals receiving serum no. 3 that received 0.1 cc of serum-virus, and one receiving serum no. 2 that received 0.5 cc of the virus died of intercurrent disease conditions. The second guinea pig given serum no. 2 that received 0.5 cc of Sao Paulo virus showed fever from the sixth

to the fourteenth day and a swollen, suspicious scrotum beginning the eleventh day. This reaction was probably due to Sao Paulo typhus infection; however, the animal concerned was but slightly ill.

All of the 18 control guinea pigs receiving Sao Paulo serum-virus no. 291 showed fever and scrotal lesions typical or suggestive of Sao

CHART-1.

PROTECTION TEST—PROTOCOLS OF GUINEA PIGS INJECTED WITH MIXTURES OF ROCKY MOUNTAIN SPOTTED FEVER CONVALESCENT GUINEA PIG SERA AND SÃO PAULO EXANTHEMATIC TYPHUS GUINEA PIG SERUM VIRUS

SERUM-VIRUS MIXTURE			NUMBER OF TEST GUINEA PIG	TEST PROTOCOLS	SERUM-VIRUS MIXTURE			NUMBER OF TEST GUINEA PIG	TEST PROTOCOLS
SPTD FEVER SERUM NO	SAO PAULO VIRUS FILT PD	AMOUNT			SPTD FEVER SERUM NO	SAO PAULO VIRUS FILT PD	AMOUNT		
		1cc	51226	RELEASED ↓			1cc	51238	DEATH–ULCER OF ↓ RECTUM
		1cc	51227	RELEASED ↓			1cc	51239	RELEASED ↓
1	4	.25cc	51228	RELEASED ↓	3	6	.25cc	51240	RELEASED ↓
		.25cc	51229	RELEASED ↓			.25cc	51241	RELEASED ↓
		.5cc	51230	RELEASED ↓			.5cc	51242	RELEASED ↓
		.5cc	51231	RELEASED ↓			.5cc	51243	RELEASED ↓
		.1cc	51232	RELEASED ↓			.1cc	51244	RELEASED ↓
		.1cc	51233	RELEASED ↓			.1cc	51245	RELEASED ↓
2	5	.25cc	51234	RELEASED ↓	4	8	.25cc	51246	RELEASED ↓
		.25cc	51235	RELEASED ↓			.25cc	51247	RELEASED ↓
		.5cc	51236	SCROTUM–SUSPICIOUS & RECOVERED–RELEASED ↓			.5cc	51248	RELEASED ↓
		.5cc	51237	DEATH–INTERCURRENT INFECTION ↓			.5cc	51249	RELEASED ↓

Paulo typhus (see chart 2), as we have observed it in several hundred guinea pigs. Of the 3 groups of 6 guinea pigs each that received 0.1 cc, 0.25 cc, and 0.5 cc, respectively, of serum-virus, 4 of each group succumbed. Necropsies were performed on all the latter animals and in each instance the gross appearance of the spleen and genital tissues was characteristic. The spleen was enlarged from 3 to 5 times, was relatively smooth, and of a deep red color; a slight surface exudate

CHART-2

CONTROLS FOR PROTECTION TESTS WITH MIXTURES OF ROCKY MOUNTAIN SPOTTED FEVER CONVALESCENT SERUM AND SÃO PAULO EXANTHEMATIC TYPHUS GUINEA PIG SERUM VIRUS

CONTROLS SÃO PAULO TYPHUS SERUM VIRUS NO. 291

CHART-3

CROSS IMMUNITY TESTS— RESULTS OF THE INOCULATION OF GUINEA PIGS RECOVERED OF ROCKY MOUNTAIN SPOTTED FEVER WITH THE VIRUS OF SÃO PAULO EXANTHEMATIC TYPHUS
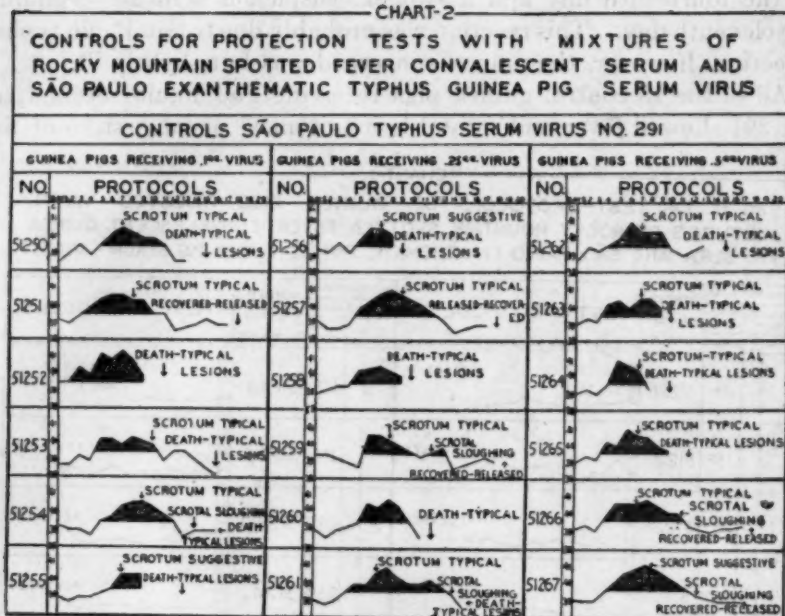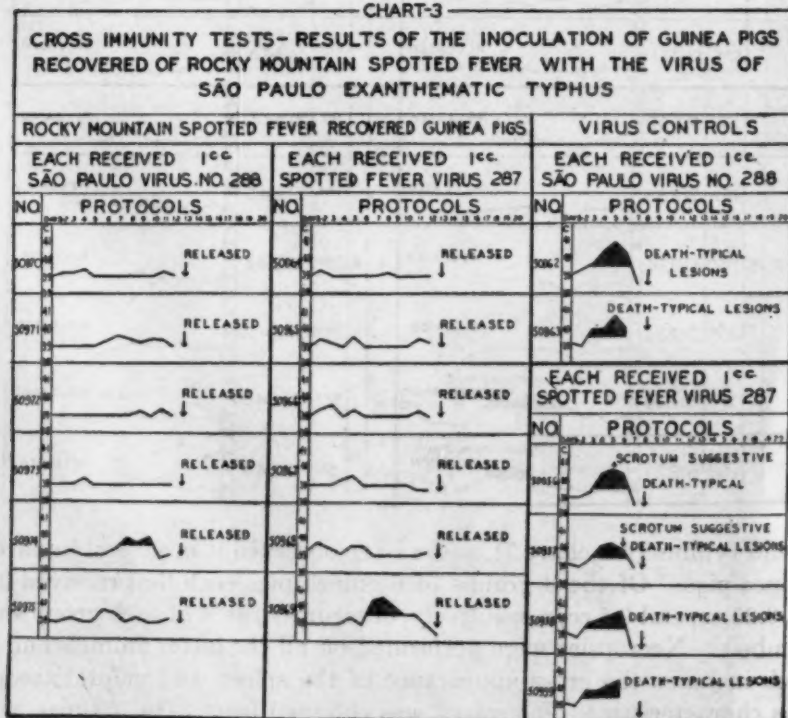
was observed in a few animals. The testes were injected in greater
or less degree and the visceral and parietal laminae of the tunica
vaginalis were partially or completely adherent. The gross appear-
ance was not essentially different from that of Rocky Mountain
spotted fever.

Cross-immunity tests (chart 3).—All of the six 8-months-recovered
Rocky Mountain spotted fever guinea pigs which were inoculated with
Sao Paulo virus no. 288, remained afebrile during the 13-day obser-
vation period, with the exception of 1 guinea pig which had low fever
from the seventh to the tenth day. The cause of the febrile reaction
was not apparent and may or may not have been a reaction to the
Sao Paulo virus.

Of 6 additional guinea pigs that were inoculated with spotted
fever virus no. 287, 5 remained afebrile, the sixth showing a febrile
reaction from the seventh to the eleventh day. As in the case of the
guinea pig in the first series, the cause of the reaction was not
apparent.

Both of the control animals that received Sao Paulo virus no. 288
died on the seventh day. Neither animal showed suggestive scrotal
lesions, but the gross appearance of the tissues was indicative of Sao
Paulo exanthematic typhus.

All four control animals receiving spotted fever virus no. 287 also
died on the seventh day. Only two showed suggestive scrotal
swelling, but necropsy findings of all were typical.

DISCUSSION

The tests here described show that the sera of guinea pigs recovered
from Rocky Mountain spotted fever have a degree of protective value
against Sao Paulo exanthematic typhus virus that is essentially spe-
cific, and that guinea pigs recovered from Rocky Mountain spotted
fever have as high degree of immunity against Sao Paulo typhus
virus as they have against that of spotted fever. Thus far only two
tests have been made to determine the degree of immunity of Sao
Paulo typhus-recovered guinea pigs to Rocky Mountain spotted
fever. In both instances the guinea pigs remained afebrile.

These data, together with our previous findings, suggest that Sao
Paulo exanthematic typhus and Rocky Mountain spotted fever are
immunologically identical.

HEATING EFFECT OF VERY HIGH FREQUENCY CON-
DENSER FIELDS ON ORGANIC FLUIDS AND TISSUES

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In recent years the investigation of the biological effects of high-frequency condenser fields has attracted no little interest on the part of research workers. On this continent Christie and Loomis (2), Hosmer (3), Carpenter and Page (1), McLennan and Burton (4), the writer (7), (8), (9), and in Europe Schliephake and Pätzold, among others both here and abroad, have studied the action of the high-frequency condenser field, both upon biological material and upon solutions of electrolytes and have demonstrated the powerful heating action exerted upon experimental material placed in such fields.

The extent of the heating of biological material in high-frequency condenser fields is related both to the dielectric constant and to the conductivity of the material. The interesting phenomenon of the relation of conductivity to heating effect was first noted by Dr. W. R. Whitney, director of the research laboratory of the General Electric Co., in connection with test runs of a 20-kilowatt short-wave oscillator, during which it was observed that solutions of electrolytes of different concentrations, when placed in the high-frequency condenser field of the oscillator, did not heat alike, one concentration heating faster than another at one frequency, while this relation might be reversed if the frequency were sufficiently changed.

This heating of electrolytes in high-frequency condenser fields was first investigated by Hosmer (2) and then, among others, by Richards and Loomis, McLennan and Burton, and in Europe, by Pätzold.

It is to the studies of McLennan and Burton on the heating of electrolytes in such fields and of the physical relations involved that we owe a better understanding of the process as applied both to electrolytes and to biological specimens.

The main facts of their inquiry summarized by them are as follows: The degree of heating of a solution of electrolyte in a high-frequency condenser field depends, not upon the composition, but on the specific conductivity, and, at a given frequency, is a maximum for a certain conductivity, whatever the size and shape of the specimen heated.

They derived a simple mathematical relation whereby the conductivity at which, for any given frequency, maximum heating occurs may be readily computed. At any given frequency the specific conductivity of the solution showing the maximum heating effect is such that $K = \frac{\nu \epsilon}{2}$, where K is the conductivity, measured in absolute units, ν is the frequency, and ϵ the dielectric constant of the specimen.

From this it follows that the conductivity at which the maximum effect occurs is proportional to the frequency, i.e., at lower frequencies the maximum heating is observed in solutions of lower concentrations than at higher frequencies. For example, at 1,560,000 cycles the concentration of a solution of potassium chloride showing the maximum heating effect is 0.00038 gram-molecules per liter; at 5,560,000 cycles it is 0.002 gram-molecules, or rather more than 5 times greater; at 22,000,000 cycles the concentration is about 0.005; at 26,000,000 cycles it is about 0.01, while, from personal observations, at 300,000,000 cycles, it is nearly 0.1.

· This heating of electrolytes in high frequency fields has an important bearing upon the extent to which biological specimens are heated when placed in such fields. If we take a heterogeneous specimen, such as the body of a laboratory animal, and place it in a condenser field, excited at some particular frequency, the distribution of the field intensity within the body will be governed largely by the respective dielectric constants of the component tissues, the degree of heating at any particular frequency by their respective conductivities.

McLennan and Burton point out, moreover, that if the electrical properties of the component tissues of the body were known, we should, by proper choice of frequency, be able to favor the heating of one portion over the other, although heat exchange between adjacent sections would tend to minimize the effect of such selective heating. Nevertheless, they suggest a therapeutic possibility which, if susceptible of development, would have wide application.

In this country, apparatus for the induction of artificial fever through exposure to high frequency fields, the so-called "radiotherm", has been designed to operate at a frequency of about 10,000,-000 cycles per second, or at a wave-length of 30 meters. In Germany therapeutic apparatus has been constructed to operate at the considerably higher frequencies of 50,000,000 to 60,000,000 cycles per second, but is adapted only to local heating effects.

Because of the relatively high concentrations of electrolyte in body tissues and fluids, and the relation, worked out by McLennan and Burton, which exists respectively between the dielectric constant, the conductivity, and the frequency at which maximum heating is observed, it would appear that, where selective heating effects for therapeutic purposes are desired, these conditions would be more nearly approached by the use of higher frequency ranges than those previously employed.

Up to the last 3 years or so, investigations of the biological effects of high-frequency fields, in the range of frequencies above 130,000,000 to 150,000,000 cycles, have seemed impracticable, because of the lack of generators with substantial power output in this range of frequencies.

However, the development by the General Electric Co. of the so-called "Magnetron" vacuum tube and the associated oscillating circuit has provided a means for the generation of high-frequency oscillations of sufficient energy for biological investigations at any desired frequency up to about 400,000,000 cycles per second, corresponding to a wave-length of 75 centimeters.

This paper accordingly reports the comparative heating effects observed in high-frequency condenser fields on a considerable number
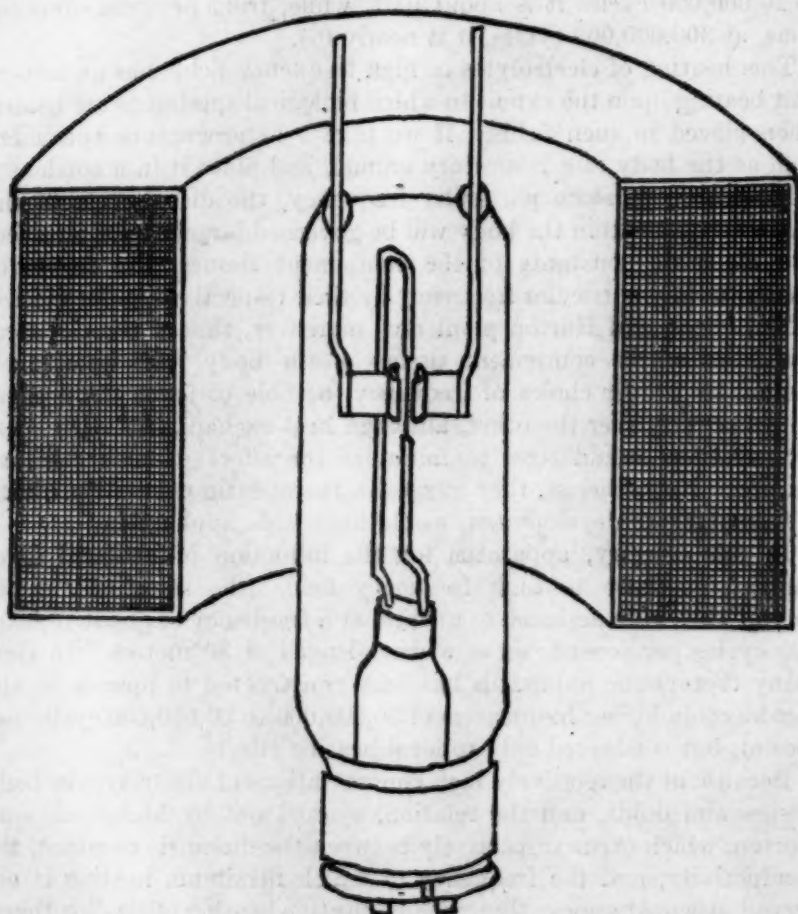
FIGURE 1.—General appearance of Magnetron tube (FH-11)

of biological fluids and tissues in a range of frequencies extending from 64,000,000 to 300,000,000 cycles per second. An attempt was also made to gain some idea of the dielectric constants of various body tissues in this range of frequencies.

The Magnetron oscillator.—The Magnetron tube and associated circuit used in carrying out these experiments are described in "Instructions GEJ-239", issued by the General Electric Co. The

tube (Magnetron FH-11) is a high-vacuum tube with a vertical, spiral, tungsten filament. On either side of the filament are two semicylindrical anodes separated, before and behind, by equal longitudinal spaces. The heavy supporting leads of the anodes are extended through the top of the tube and serve as external connections to the circuit. Figure 1 gives an idea of the general appearance of the tube, which has a maximum anode dissipation of energy of 60 watts.

The tube, when employed as a high-frequency generator, is used with the appropriate circuit in conjunction with a polarizing magnetic field. This field, in the center of which the tube is mounted, is furnished by a large "doughnut" coil 5 inches thick, having outside and inside diameters of 11 and 5 inches, respectively, and consisting of approximately 2,700 turns of no. 14 enameled copper wire. When energized by a 110-volt direct current, the field strength is varied by means of a sliding contact resistance in series with the coil from about 600 gausses, the required field strength for a wave length of 75 cm up to 800 gausses, the field strength required for wave lengths of 5 meters or more.

Figure 2 is a diagram of the oscillatory circuit used with the tube. It will be noted that the anode voltage is applied to the midpoint of the inductance connected across the anode leads. For frequencies in excess of about 80,000,000 cycles, the interelectrode capacity of the tube is enough for the generation of oscillations. For the lower range of frequencies, additional capacity must be

FIGURE 2.—Diagram of oscillatory circuit used with Magnetron tube.

connected across these leads. In the form of oscillator worked out at this laboratory, a rack and pinion, mounted at the rear of the polarizing coil, operates a trombone-slide arrangement of rods within brass tubes, thus permitting the frequency to be varied within the limits of the sliding adjustment. The range of frequencies can be changed by unscrewing one tube-and-rod combination and substituting another of different length. Demountable disk condensers, making contact with the anode leads through phosphor-bronze springs, furnished additional variable capacity, as required. A 5,000-ohm fixed resis-
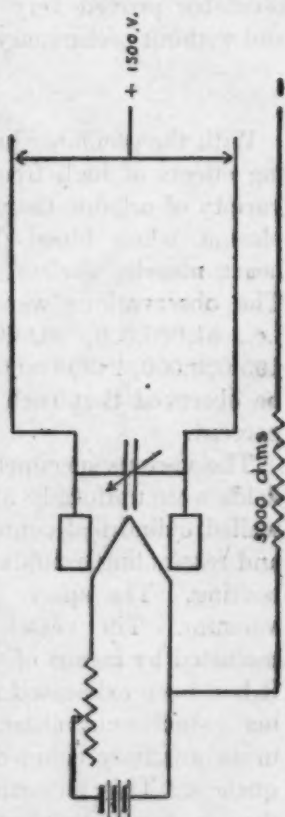
tance with a current capacity of 250 to 300 milliamperes, mounted in
the anode-return lead, is required for stable operation.

Figure 3 shows the appearance of the oscillator when adjusted for
a wave length of 5 meters. The frequency at which the oscillator
was working was determined by means of a Lecher wire system
mounted behind and in the neighborhood of the oscillator. The
oscillator proved very satisfactory, for it operated with steadiness
and without preliminary coaxing at any frequency for which it was set.

EXPERIMENTAL

With the oscillator just described, a study of the comparative heat-
ing effects of high frequency condenser fields was carried out on a
variety of organic tissues and fluids. These were as follows: Serum,
plasma, whole blood (heparinized), washed red cells, liver, spleen,
heart muscle, skeletal muscle, kidney, pancreas, brain, and lung.
The observations were carried out at eight different frequencies,
i.e., 64,000,000, 80,000,000, 100,000,000, 125,000,000, 156,000,000,
195,000,000, 242,000,000 and 300,000,000 cycles per second. It will
be observed that each frequency differs from the next lower by 25
percent.

The various specimens exposed to the action of the high-frequency
fields were uniformly 5 cc in volume. They were placed in a double-
walled cylindrical container of pyrex glass (fig. 5) holding about 9 cc
and resembling a miniature thermos flask minus the internal metallic
coating. The space between the walls was exhausted to a high
vacuum. The vessel containing the specimen to be tested was
mounted by means of the tubulation at the lower end through which
it had been exhausted in a holder between two condenser plates hav-
ing a similar curvature, but separated by an air space from the vessel
in an auxiliary coupled circuit, carefully tuned to the oscillator fre-
quency. This inductively coupled circuit was formed of the con-
denser plates mentioned above, the vessel containing the specimen
and a loop formed by equal arcs of heavy wire, connecting the con-
denser plates with the terminals of a thermal ammeter which, in this
manner, was symmetrically inserted in the circuit. A scratch mark
on the vessel insured its orientation in the same position with respect
to the field when replaced after removal for changing specimens.

The mercury thermometer for measuring the rise in temperature
was calibrated by comparison with an Anschütz thermometer with
Bureau of Standards certificate.

The thermometer was so placed in the specimen that the bulb
occupied the central portion, the distance from the upper and lower
ends of the bulb to the surface and bottom, respectively, being the
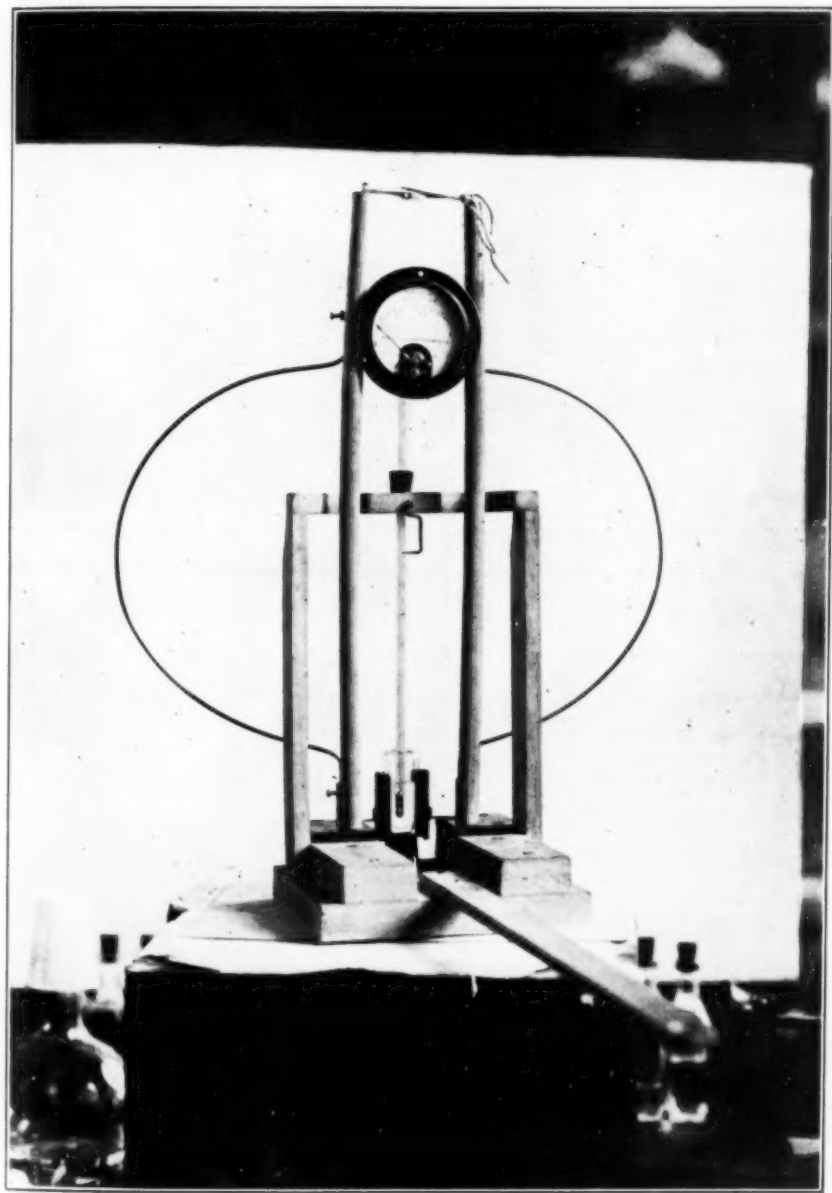same. The thermometer was inserted through a well-fitting cork,

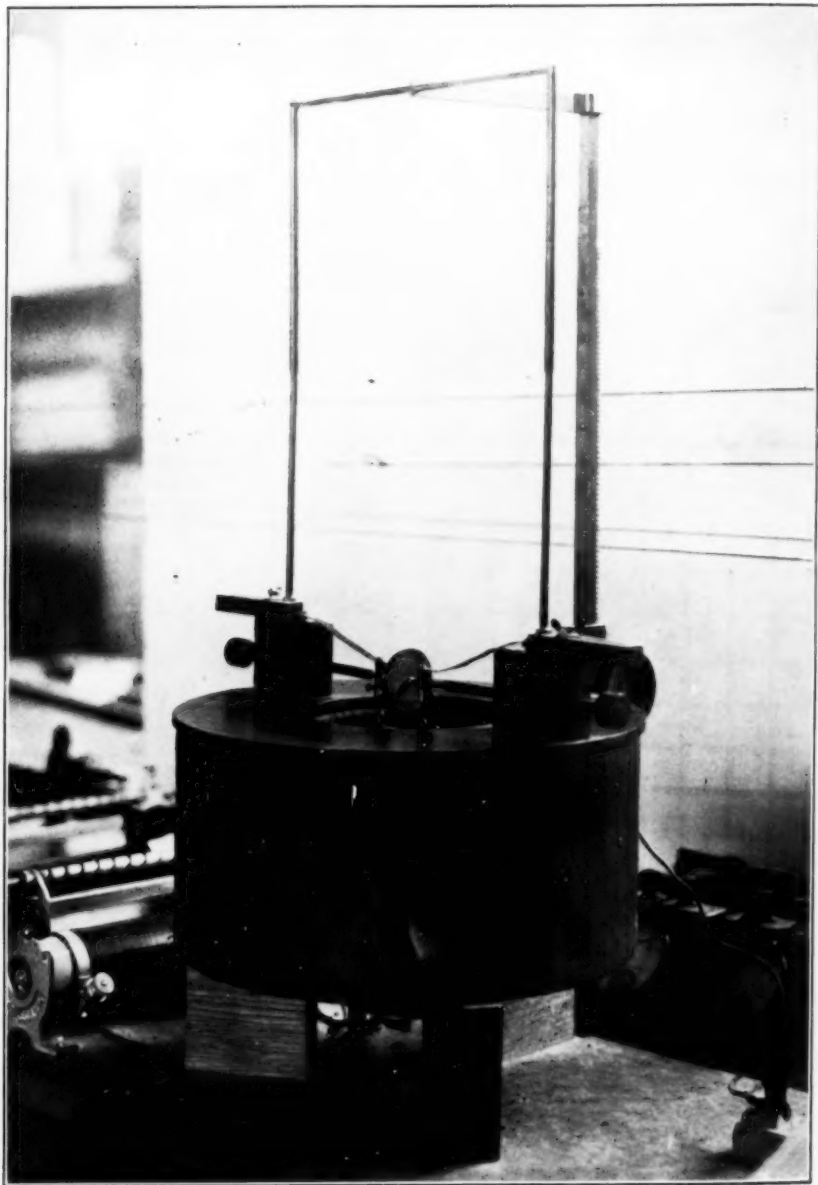FIGURE 3.—Magnetron oscillator adjusted for a frequency of 60 × 10⁶ cycles (wave length, 5 meters).

FIGURE 4.—Auxiliary coupled circuit adjusted for a frequency of 10⁸ cycles.

fitted in turn to a hole in a horizontal support about 17 cm above the upper edge of the vessel. A sharp-pointed indicator was mounted on the thermometer support so that by bringing it exactly upon a selected degree of the thermometer scale, a constant depth of immersion of the bulb in the specimen was insured. Great care was taken to orient the thermometer in the vertical axis of the specimen as well as to secure constant depth of immersion. The use of a mercury thermometer as a measuring device was permissible, as the high-frequency field does not heat metallic substances.

By paying careful attention to the tuning of the coupled circuit to the oscillator frequency, relatively loose coupling could be employed, thus preventing changes in the frequency of the oscillator through mutual reaction of the two circuits. A long wooden handle attached to the base of the support for the auxiliary circuit permitted the observer, by means of slight changes in the coupling, to keep the needle of the meter in the coupled circuit always upon the selected division of the meter scale. In practice it was found easy to keep the meter needle upon the selected point with an accuracy of ± 0.1 of a division. As the main divisions on the meters used were graduated in twentieths, the current indication could be kept constant to one part in 200.

All tuning adjustments with respect to both circuits were made with the coupled circuit in proper inductive relation to the oscillator. The frequency was also repeatedly checked during runs. The general appearance of the auxiliary coupled circuit, adjusted for a frequency of 100,000,000 cycles, is shown in figure 4.

The organic tissues and fluids used in these studies were derived from dogs,

FIGURE 5.—Cross section of double-walled specimen container

as they were at hand in sufficient numbers. After being anesthetized, the animals were exsanguinated through a canula in the carotid artery. A portion of the first blood was received into a cylinder containing sufficient heparin to prevent coagulation. This served as a source of material for tests on whole blood, plasma, and corpuscles. The remainder was received into a jar, covered hermetically (to prevent evaporation), and served as a source of blood serum after clotting had occurred. The various organs as they were
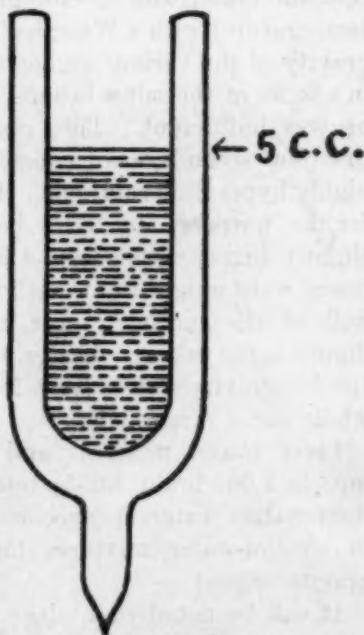
removed were received in large cintment jars of opal glass, with tight-fitting screw lids. All tissues and fluids, except when being tested, were kept at 4° C. This was necessary as it was usually impracticable to prepare the specimens and finish the runs on any one working day. The fluids (serum, plasma, whole blood, washed red cells) were measured out into the vessel by means of a calibrated pipette. The equivalent amount of the solid tissues was determined in the manner here described. A condition which had to be met was the requirement that the various specimens should all occupy the same *volume* in the high frequency condenser field, which was necessary if the energy density of the field was to be comparable per unit of volume. Since the specific gravity of the various organs is different, preliminary specific gravity determinations were necessary. These were secured with sufficient accuracy for the purpose by preparing a series of salt solutions differing in concentration from each other by 1 percent and taking the specific gravity of each at 20° C. (laboratory temperature) with a Westphal specific gravity balance. The specific gravity of the various organs was determined by dropping small bits in a series of the salt solutions, noting whether the tissue sank, floated, or was indifferent. This observation had to be made within the first few seconds, as of course water was rapidly extracted by the highly hypertonic solutions. However, this method proved adequate for the purpose, any error being in the direction of assigning a slightly higher rather than a lower specific gravity. Since the specimens were weighed out, such error, if any, would tend to make the bulk of the specimen more, rather than less, than 5 cc and thus diminish the energy density through the specimen. The following specific-gravity values were found to be practically constant for the whole series of animals:

Liver, spleen, pancreas, and skeletal muscle 1.07; kidney and heart muscle 1.06; brain 1.055; testicle 1.035; lung 0.94 (since lung was lighter than water, its specific gravity determination was carried out in alcohol-water mixtures for which there are extended specific gravity tables).

It will be noted that, since the tissues were removed from exsanguinated animals, they contained a much reduced quantity of blood. A special technique would, of course, have been required to produce completely exsanguinated tissues. The tissues, before being exposed to the action of the high frequency field, were first run through a meat grinder, and then the amount equivalent to 5 cc (as determined by the specific gravity) was weighed out on scales sensitive to 1 mg. The tissue was then introduced into the vessel, care being taken to pack the tissue homogeneously and to exclude air bubbles.

The usual order of procedure at any frequency was to make the heating determinations on the whole blood, then upon plasma and

red corpuscles, the determination upon blood serum being postponed until the following day so as to permit the complete separation of the serum from the clot. Red blood cells were washed free from plasma by three consecutive centrifugalizations, the red cell suspension being about 95 percent red blood cells. The washing was conducted with physiological (0.8 percent) salt solution. It will be noted that an 0.8 percent salt solution has a molar concentration (for sodium chloride) equivalent to approximately somewhat less than a one-seventh normal solution; and so the frequency at which maximum heating would take place for a solution of this concentration would, for a solution of KCl, be in the neighborhood (at 28° C.) of 435,000,000 cycles per second, or a wave-length of about 69 cm—a frequency well beyond the range of the oscillator. In this connection trials were made of isotonic non-electrolyte solutions in which to suspend the red cells. A 3 percent solution of glucose was found to be practically isotonic with red cells, and trial of this solution as a means of suspension was made. However, its use was abandoned because red cells settled very poorly on centrifugalization on account of the relatively high specific gravity of the glucose solution. On trial, the degree of heating of physiological salt solutions, when placed in the high frequency field, was found to be low, considerably lower than that of blood serum even at the highest frequencies studied. This was, accordingly, the medium used for suspending the red cells.

Table 1 gives the results obtained in the range of frequencies mentioned above. In this table the degree of heating observed in blood serum is set down as 100, and the heating observed in all the other tissues and fluids is compared therewith.

TABLE 1.—*The relative heating in high-frequency fields of various body fluids and tissues*

Frequency	Wave-length	Serum	Whole blood	Red cells	Plasma	Liver	Spleen	Heart muscle	Temporal muscle	Kidney	Brain	Pancreas	Lung
	Meters												
3 × 10⁸	1.0	100.0	116.2	124.0	105	122	116.2	109	110	116	145	142	157
2.42×10⁸	1.24	100.0	122.5	137.0	102	128	125.9	111.0	107	120.5	146	149	145
1.95×10⁸	1.54	100.0	124.7	149.7	96	137	129	119.5	119.5	119.5	143	152	157.5
1.55×10⁸	1.93	100.0	154.0	161.0	115	162	150	151.0	143.0	142.0	165	153	181
1.25×10⁸	2.40	100.0	123.5	163.0	105	170	163.5	154.0	149	132.0	176	217	185
1.0×10⁸	3.00	100.0	147.0	177.0	105	184	162.0	146.0	146	158.5	176.5	177.5	190
8×10⁷	3.75	100.0	157.0	171.0	100	184	179	156.0	157	172.0	199	207	208
6.4×10⁷	4.69	100.0	151.0	192.0	110	215	192	170.0	162	173.0	234	199	199

From inspection of the table the following points are evident:

First, that all the body tissues and fluids show a greater degree of heating in the high-frequency field than does blood serum; that plasma, as might be expected, shows but little different heating qualities from those of blood serum, but, on the whole, except at one frequency

(195,000,000 cycles), tends to heat more. Whole blood heats considerably more than serum, the maximum difference being at 80,000,-000 cycles, the minimum at 300,000,000. Red cells generally heat much more than either plasma or serum, the maximum effect being noted at 64,000,000 cycles, at which frequency the heating of red cells was nearly twice that of blood serum. At the two highest frequencies, 242,000,000 and 300,000,000 cycles, the differences between the heating effect of the various tissues and fluids tended to be ironed out, all the organs, and fluids, with the exception of brain, pancreas, and lung, showing only moderate heating in excess of that displayed by blood serum. Liver, brain, pancreas, and lung are conspicuously well heated by the high-frequency field. The maximum effect on liver and brain compared with blood serum was observed at 64,000,000 cycles, that on pancreas at 125,000,000 cycles, on lung at 80,000,000 cycles. Kidney, on the whole, heated less than the other viscera tested, the general degree of heating observed being about the same as that of heart muscle and skeletal muscle, which tissues resemble each other in heating characteristics.

One of the inferences to be drawn from the table is that the higher the frequency at which the field is excited, the more nearly uniform is the comparative extent to which the various tissues and fluids are heated, although brain, pancreas, and lung continue to retain their high relative heating. The use of any such frequency as 300,000,000 cycles for therapeutic purposes, however, although such frequency would tend to produce rapid and more nearly uniform heating of all exposed tissues, is, of course, out of the question, not only because of the lack of any apparatus capable of substantial output at this frequency but also because of the impracticability from physical considerations of devising any circuit for specimens of considerable size, such as the human body or even portions thererof, larger, say, than 10 or 15 cc, which could be resonated with a generator operating at this frequency. The only possibility, and that rather remote, would be the discovery of a generator capable of operating at such frequency with an output so great that current flow by means of "shock-excitation" could be caused in objects placed in the field even if the natural period of such circuit was far below that of the generator.

However, at the lower frequencies considerable differential heating in some of the organs was manifest. Frequencies of the order of, say, 50,000,000 to 60,000,000 cycles, are not too high to exclude their use for therapeutic purposes, especially for heating portions of the human anatomy.

For example, as previously mentioned, apparatus has been developed in Germany, operating at a frequency of 50,000,000 to 60,000,000 cycles, which is adapted to the treatment of portions of the body, such as the thigh, a knee, or a shoulder joint, and might even be used for

thoracic treatment. Schliephake (11), in Germany, has made use of frequencies, for therapeutic purposes, of between 15,000,000 and 100,000,000 cycles per second. His general conclusions from clinical observations in staphylococcus infections were that the most rapid curative effects were obtained at frequencies of from 60,000,000 to 100,000,000 cycles. He had the impression that in the 35,000,000 to 30,000,000 range there was a zone in which a favorable outcome required a much longer time. At a frequency range of from 25,-000,000 to 20,000,000 cycles good results again seemed to follow more rapidly, whereas at 15,000,000 cycles the results were much worse.

In connection with the relative heating of tissues, it is of interest to note that Schliephake has already conducted tests of the relative heating of different tissues at a considerably lower range of frequencies than those here reported. The tissues concerned were subcutaneous tissue, muscle, bone, and fat, the relative heating of the last three being compared with that of the subcutaneous tissues. The observations covered a frequency range of from 21,400,000 to 85,000,000 cycles. At the lowest range the relative heating of the four tissues was, in the order given above, 10, 5.5, 2.5, and 4, respectively. At a frequency of 66,000,000 cycles, where the most nearly uniform heating of these 4 kinds of tissue was observed, the relative heating, respectively, was 10, 9, 6.4, and 7.5.

The high relative heating of lung tissue, particularly at or near frequencies which, by a suitable design of apparatus, could probably be used for therapeutic purposes, suggests the possibility of the use of this range of frequencies as an auxiliary in the treatment of lung conditions characterized by a local inflammatory process such as lobar pneumonia. There is, of course, nothing new in the suggestion of diathermy for the treatment of pulmonary inflammation. However, at the relatively low frequencies and broad emission characteristic of conventional diathermic apparatus, but little selective heating of lung tissue could be expected, as most of the heating would occur in the subcutaneous tissues and the bones. On the other hand, at the range of frequencies at which these observations were begun, say in the neighborhood of 60,000,000 cycles, for which frequencies oscillators with excellent output could readily be designed and constructed, it would appear practicable, by suitable location of condenser plates, to heat selectively some designated lobe of the lung to a desirable extent, without, at the same time, unduly heating the intervening tissues. The results obtained in the experiments on relative heating would appear to warrant some investigations of such possibility, at least on the larger laboratory animals. There is, however, one difficulty in the way of selective heating which must not be lost sight of, and that is the extent to which temperature *per se* operates upon conductivity to increase this factor. Any therapeutic application of high-

frequency fields to raise the temperature of body parts above the normal must take into account the consideration that the conductivity of the component parts must, at body temperature, be considerably (34 to 36 percent) higher than if they were cooled to room temperature. An increase of 3° or 4° C. in the temperature of a treated part would still further raise its conductivity by an additional 6 or 8 percent. From this it follows that a range of frequencies, which, on theoretical grounds, might show good selective heating effects, provided the tissues did not greatly exceed in temperature the surrounding air, might well be less effective at the much higher body temperature. For this reason, if we were free to choose, we would select a range of frequencies higher than those which, from the data reported in table 1, we might be inclined to select. But here we would encounter the difficulties and limitations imposed in the choice of such higher frequencies by the physical considerations of inductance and capacity which necessarily, under existing conditions, limit our choice of frequencies to those susceptible of practical application with existing facilities.

THE DIELECTRIC CONSTANTS OF BODY TISSUES

In connection with the experiments just reported, and because of the important relation shown by McLennan and Burton to exist between dielectric constant, conductivity, and frequency, with respect to the heating caused by high-frequency fields, an attempt was made to gain a rough idea of the dielectric constants of some of the body tissues at these high frequencies. That these did not differ greatly from that of water was already shown by the circumstance that, in the experiments dealing with the relative heating in high-frequency fields of body fluids and tissues, the auxiliary circuit was resonated to the oscillator frequency with distilled water as the fluid in the vessel. The circuit was then found to be in excellent resonance with the oscillator when a like volume of body fluids and tissues was substituted for the water in the heating tests. The use of 5 cc of some liquid having a lower dielectric constant than that of water, such as 98 percent ethyl alcohol, was followed by severe detuning of the resonator.

Since only an approximate idea of these dielectric constants was desired, no great accuracy was attempted, use being made of the following resonance method: Short pieces of no. 10 copper wire, with the ends ground flat and heavily silver plated, were sealed with DeKhotinsky cement in two holes opposite each other, halfway down a cylindrical glass vessel holding about 12 cc. The distance separating the ends of the wire inside the vessel was about 4 mm. The external

ends of the wires were each connected by a length of stout copper wire to the terminals of a thermal galvanometer. This formed a resonating circuit similar to those already employed to study the heating effect of the high frequency fields upon organic fluids and tissues, with the difference that the two wires and their flat terminal surfaces, together with the material in which they were immersed, formed the capacity in the circuit. The amount of material required in the vessel to include all the lines of force passing through the condenser was first ascertained by introducing successive portions of distilled water into the vessel until further additions of distilled water produced no decrease in the resonant frequency of the circuit. This point was reached when 9 cc of distilled water had been put into the vessel. In the determinations, 10 cc of distilled water and a corresponding amount of the specimens, the dielectric constants of which were to be determined, was employed. The dielectric constant of the material, as compared with water, would then be approximately determined by comparing the squares of the wave lengths generated by the oscillator when resonated as closely as practicable with the circuit containing the specimen to be tested with the square of the resonating wave length found with 10 cc of water. Since the resonance indicator was a thermal galvanometer (responsive to relatively low currents), very loose coupling with the oscillator could be employed. Hence the "drag" of the resonator upon the oscillator was negligible.

The first material with respect to which determination of the dielectric constant was attempted was heparinized whole rabbit's blood. The attempt was unsuccessful because the conductivity of the blood was so high as to prevent the obtaining of a maximum sufficiently sharp on the thermal galvanometer to indicate resonance of the system with the oscillator. However, fair determinations were practicable with the following material:

Rat's brain, liver, spleen, muscle, and kidney fat. All determinations were carried out at the normal laboratory temperature of about 20° C. The material was first minced with sharp curved scissors, and 10 cc were introduced into the vessel by careful packing so as to exclude all air bubbles and insure as nearly as practicable a homogeneous texture. Five consecutive wave-length determinations were made in the case of brain, liver, spleen, and muscle. In the case of kidney, enough material was available at the time for but 3 such determinations, and for but 2 in the case of the kidney fat.

The following results were obtained:

TABLE 2.—*Dielectric constants of various rat tissues*

[λ= Wave length H₂O=2.8]

Material	Wave length	$\frac{\lambda'^2}{\lambda^2}$	Dielectric constant e if e of water is 78.54 at 25° C.
	λ'		
Brain	2.81	1.0	78.54
Liver	2.754	.967	75.95
Spleen	2.78	.988	77.6
Muscle	2.78	.988	77.6
Kidney	2.76	.972	76.2
Kidney fat	1.16	.173	13.6

With the exception of kidney fat it will be noted that the dielectric constants of these various viscera did not differ materially at this high frequency from that of water. That of brain was practically identical, that of liver somewhat lower than the others. The low dielectric constant of the perinephritic fat is in line with the low dielectric constants of fatty substances in general. For example, according to the physical chemical tables of Landolt-Bornstein (1st supplementary vol., 1932, pp. 562–63) the dielectric constants at 20° C. of castor oil, olive oil, and linseed oil are, respectively, about 4.8, 3.3, and 3.3. We should expect fresh kidney fat to contain a certain amount of moisture and also some proteid material in the supporting areolar tissue and in the walls of the fat cells. This would readily account for a higher dielectric constant than that of the oils mentioned above. In adjusting the oscillator to the resonating frequency of the kidney fat, the sharpness of resonance was considerably greater than was the case with respect to the other tissues, thus indicating a considerably lower specific conductivity. Were data at hand as to the specific conductivity of this tissue, the frequency at which maximum heating would take place could be computed with a fair degree of probability. At all events this frequency should be considerably lower than the frequencies for other body tissues, because of the low conductivity. On the other hand, because of the low dielectric constant, the frequency at which maximum heating occurs would be considerably higher than for material having a like conductivity, but a dielectric constant approximating that of water.

SUMMARY

The Magnetron tube and associated circuit permit the generation of electromagnetic oscillations up to a frequency of 400,000,000 cycles per second. Investigation of the comparative heating of various body tissues and fluids was carried out in a range of eight different frequencies beginning at 64,000,000 and ending at 300,000 000 cycles per second, each frequency differing from its predecessor by

25 percent. The heating of blood serum was the standard to which the heating of all the other tissues was referred. Compared with blood serum, the most conspicuous differences in heating of the various organs and tissues were observed in the case of the lower frequencies. At the highest frequency $(30 \times 10^7$ cycles) the relative heating tended to become more nearly uniform, although lung and brain tissue still showed a considerably greater tendency to heat than did blood serum even at this frequency.

An attempt was made to gain an approximate idea of the dielectric constants of some body tissues and fluids in this range of frequencies, employing a resonance method. Because of the high conductivity of whole blood, the attempt to obtain its dielectric constant failed. Approximate values of dielectric constants were obtained for brain, liver, spleen, muscle, and fat. With the exception of fat, the approximate values of the other dielectric constants differed but little from the dielectric constant of water, that of brain being practically identical, and that of liver being about 96 percent that of water. Fat showed a low dielectric constant, in the neighborhood of 13.6, which is higher than this value in vegetable oils, such as castor, olive, and linseed oils. The higher figure may be due to the presence of moisture and proteids in the fresh fat.

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COURT DECISION RELATING TO PUBLIC HEALTH

Conviction for unlawful possession of morphine affirmed.—(California
First District Court of Appeal, Div. 1; *People* v. *Sinclair*, 19 P. (2d)
23; decided Jan. 28, 1933.) The defendant and another were charged
jointly with having had in their possession unlawfully a quantity
of morphine. They were tried together and found guilty, and each
was sentenced to a term of imprisonment. The defendant ap-
pealed and urged, as one ground for reversal, that the evidence
as to him was insufficient to sustain the conviction.

It appeared that an inspector of the State narcotic division and
an informer entered an automobile driven by the defendant after
the inspector had been introduced to the defendant by the informer.
The inspector then told defendant that he wanted to buy some
morphine. Both the inspector and the informer gave the defend-
ant some marked money for the purchase of the morphine. The
defendant then drove the automobile to a certain place where he
picked up his codefendant. The car then proceeded only a short
distance when it was crowded to the curb and stopped by a car
driven by another narcotic inspector. When the defendant saw
the other car closing in, he directed his codefendant to "drop the
window and throw that out." Complying, the codefendant im-
mediately threw a match box into the street. When picked up
by one of the inspectors, the box was found to contain two cubes
of morphine.

The district court of appeal stated that "Where, as here, posses-
sion, as distinguished from sale, is charged, in order to establish
guilt it is essential to prove that the possession was immediate and
exclusive and under the dominion and control of the person charged
with such possession", and held that the facts were amply sufficient
to establish all of the elements of the crime.

The defendant argued that it was necessary to show that the
person accused had the unlawful article on his person, but the court
said that "manifestly, such is not the law, because, if it were, it
would exclude entirely from the operation of the statute (Deering's
Gen. Laws Supp. 1925–27, act 5994, sec. 8) cases of joint posses-

sion, or possession by carrying the illegal article in an automobile or other conveyance, or keeping it in some place under the immediate and exclusive control of the accused."

The judgment of the lower court was affirmed.

DEATHS DURING WEEK ENDED JULY 1, 1933

[From the Weekly Health Index issued by the Bureau of the Census, Department of Commerce]

	Week ended July 1, 1933	Corresponding week, 1932
Data from 85 large cities of the United States:		
Total deaths	7, 283	7, 094
Deaths per 1,000 population, annual basis	10. 2	10. 1
Deaths under 1 year of age	522	561
Deaths under 1 year of age per 1,000 estimated live births [1]	43	44
Deaths per 1,000 population, annual basis, first 26 weeks of year	11. 5	12. 0
Data from industrial insurance companies:		
Policies in force	67, 779, 572	72, 288, 818
Number of death claims	12, 192	13, 658
Death claims per 1,000 policies in force, annual rate	9. 4	9. 9
Death claims per 1,000 policies, first 26 weeks of year, annual rate	10. 5	10. 2

[1] 81 cities.

PREVALENCE OF DISEASE

No health department, State or local, can effectively prevent or control disease without knowledge of when, where, and under what conditions cases are occurring

UNITED STATES

CURRENT WEEKLY STATE REPORTS

These reports are preliminary, and the figures are subject to change when later returns are received by the State health officers

Reports for Weeks Ended July 8, 1933, and July 9, 1932

Cases of certain communicable diseases reported by telegraph by State health officers for weeks ended July 8, 1933, and July 9, 1932

Division and State	Diphtheria		Influenza		Measles		Meningococcus meningitis	
	Week ended July 8, 1933	Week ended July 9, 1932	Week ended July 8, 1933	Week ended July 9, 1932	Week ended July 8, 1933	Week ended July 9, 1932	Week ended July 8, 1933	Week ended July 9, 1932
New England States:								
Maine		1			1	48	0	0
New Hampshire		1			6	23	0	0
Vermont		1			41	56	0	0
Massachusetts	11	28			413	467	1	0
Rhode Island	1	1			1	16	0	0
Connecticut	2	1	1	1	58	100	0	0
Middle Atlantic States:								
New York	36	70	[1] 3	[1] 3	697	987	1	6
New Jersey	20	25	3	1	323	414	1	3
Pennsylvania	27	44			420	518	2	2
East North Central States:								
Ohio	29	18		6	283	319	3	1
Indiana	7	17	13	8	34	29	1	1
Illinois	19	41	18	6	178	260	9	0
Michigan	21	13		1	171	934	0	1
Wisconsin	1	2	5	9	127	363	1	0
West North Central States:								
Minnesota	4	5		1	31	32	0	1
Iowa	6	9			7	2	1	0
Missouri	23	21		1	64	13	1	0
North Dakota	2				29	6	0	0
South Dakota		4			4	1	0	0
Nebraska	4	7		5	45	2	0	0
Kansas	2	4		1	34	54	0	0
South Atlantic States:								
Delaware	2				6		0	0
Maryland [1] [1]	11	6	1	1	8	10	0	0
District of Columbia [1]	1	10	1		11	5	0	0
Virginia	3	7			55	58	0	1
West Virginia	13	12	1	7	12	173	1	1
North Carolina	12	11		4	74	186	0	1
South Carolina [1]	5	3	115	123	66	82	0	0
Georgia [1]	8	7		18	50	32	0	1
Florida [1]	4	5	1		19	1	0	0

See footnotes at end of table.

Cases of certain communicable diseases reported by telegraph by State health officers for weeks ended July 8, 1933, and July 9, 1932—Continued

Division and State	Diphtheria		Influenza		Measles		Meningococcus meningitis	
	Week ended July 8, 1933	Week ended July 9, 1932	Week ended July 8, 1933	Week ended July 9, 1932	Week ended July 8, 1933	Week ended July 9, 1932	Week ended July 8, 1933	Week ended July 9, 1932
East South Central States:								
Kentucky	7	------	------	------	17	------	0	1
Tennessee	5	8	5	12	94	1	2	3
Alabama [4]	7	12	5	3	22	2	1	1
Mississippi	2	6	------	------	------	------	0	0
West South Central States:								
Arkansas	5	3	3	2	68	------	1	0
Louisiana	10	15	6	14	9	------	0	0
Oklahoma [3]	10	------	6	8	11	11	0	1
Texas [4]	49	34	44	19	153	91	0	3
Mountain States:								
Montana [3]	1	2	------	------	17	24	0	1
Idaho	1	------	1	------	1	------	0	0
Wyoming [3]	------	------	------	------	1	14	0	0
Colorado [3]	3	4	------	------	5	29	0	0
New Mexico	5	4	------	------	6	1	0	0
Arizona	3	------	------	2	15	1	0	0
Utah [3]	------	------	------	------	27	4	0	1
Pacific States:								
Washington	1	3	1	------	32	77	1	0
Oregon [3]	2	4	5	3	30	34	0	1
California	29	17	15	34	343	103	2	4
Total	414	486	253	293	4,119	5,583	29	35

Division and State	Poliomyelitis		Scarlet fever		Smallpox		Typhoid fever	
	Week ended July 8, 1933	Week ended July 9, 1932	Week ended July 8, 1933	Week ended July 9, 1932	Week ended July 9, 1933	Week ended July 9, 1932	Week ended July 8, 1933	Week ended July 9, 1932
New England States:								
Maine	0	2	2	10	0	0	0	5
New Hampshire	0	0	14	8	0	0	0	1
Vermont	0	0	2	3	0	1	0	0
Massachusetts	7	0	93	190	0	0	3	2
Rhode Island	0	0	10	11	0	0	0	0
Connecticut	0	1	23	17	0	0	0	2
Middle Atlantic States:								
New York	4	3	177	257	0	0	31	14
New Jersey	0	1	48	84	0	0	6	8
Pennsylvania	0	4	177	255	0	0	8	14
East North Central States:								
Ohio	1	3	184	73	5	7	37	21
Indiana	1	1	21	28	1	8	5	7
Illinois	3	3	115	110	2	2	31	23
Michigan	0	1	158	190	1	3	3	8
Wisconsin	0	0	36	16	7	1	1	2
West North Central States:								
Minnesota	1	2	11	31	0	9	0	1
Iowa	1	1	11	5	6	2	0	2
Missouri	1	0	13	9	1	0	5	19
North Dakota	1	1	2	------	2	0	1	0
South Dakota	0	0	5	5	0	0	0	1
Nebraska	0	1	14	9	6	2	1	0
Kansas	0	0	8	8	0	1	16	6
South Atlantic States:								
Delaware	0	0	3	7	0	0	3	1
Maryland [3][3]	3	0	22	18	0	0	11	13
District of Columbia [3]	0	0	3	4	0	0	0	3
Virginia	0	0	17	20	0	2	40	55
West Virginia	0	1	13	3	0	0	20	26
North Carolina [4]	0	0	14	9	0	0	37	28
South Carolina [4]	0	2	------	5	0	0	47	50
Georgia [4]	0	0	5	4	0	3	46	51
Florida [4]	0	0	------	------	0	0	0	0

See footnotes at end of table.

Cases of certain communicable diseases reported by telegraph by State health officers for weeks ended July 8, 1933, and July 9, 1932—Continued

Division and State	Poliomyelitis		Scarlet fever		Smallpox		Typhoid fever	
	Week ended July 8, 1933	Week ended July 9, 1932	Week ended July 8, 1933	Week ended July 9, 1932	Week ended July 8, 1933	Week ended July 9, 1932	Week ended July 8, 1933	Week ended July 9, 1932
East South Central States:								
Kentucky	1	1	9	12	0	0	65	70
Tennessee	5	0	15	9	0	3	75	114
Alabama [4]	0	1	12	12	0	10	34	20
Mississippi	1	1	8	5	1	2	23	27
West South Central States:								
Arkansas	2	0	2	3	0	0	26	23
Louisiana	1	0	4	1	0	0	27	23
Oklahoma [5]	0	2	7	8	0	2	25	23
Texas [4]	3	4	33	22	9	13	64	103
Mountain States:								
Montana [3]	0	0	7		0	3	5	3
Idaho	0	0			0	3	0	7
Wyoming [3]	0	1	6	4	1	0	0	0
Colorado [3]	0	0	5	12	1	0	2	2
New Mexico	0	0	2	4	0	0	1	6
Arizona	0	0	3		1	0	1	1
Utah [3]	0	0	3	1	0	0	3	0
Pacific States:								
Washington	0	3	20	12	6	6	1	3
Oregon [3]	1	0	10	5	2	7	8	2
California	3	3	88	40	8	5	6	6
Total	40	43	1,435	1,539	60	90	727	804

[1] New York City only.
[2] Week ended Friday.
[3] Rocky Mountain spotted fever, week ended July 8, 1933, 17 cases, as follows: Maryland, 1; District of Columbia, 1; Montana, 2; Colorado, 1; Wyoming, 10; Oregon, 2.
[4] Typhus fever, week ended July 8, 1933, 76 cases, as follows: South Carolina, 1; Georgia, 25; Florida, 2; Alabama, 35; Texas, 13.
[5] Exclusive of Oklahoma City and Tulsa.

SUMMARY OF MONTHLY REPORTS FROM STATES

The following summary of cases reported monthly by States is published weekly and covers only those States from which reports are received during the current week.

State	Menin- gococ- cus menin- gitis	Diph- theria	Influ- enza	Malaria	Measles	Pellagra	Polio- myelitis	Scarlet fever	Small- pox	Ty- phoid fever
May 1933										
Mississippi	1	19	893	3,444	1,539	727	4	17	2	23
June 1933										
Arkansas	2	12	1	214	379	140		3	8	65
Connecticut		11	6		763		2	223	0	5
District of Columbia	1	7	1		100	1	0	32	0	2
Maine	1	7	7		10		1	46	0	15
Nebraska	5	19			371		1	40	18	3
North Dakota	3	6	1		505		1	21	1	3
Vermont		1			278		0	24	0	1
Wyoming		1			19		0	24	0	4

May 1933

Mississippi:	Cases
Chicken pox	324
Dengue	9
Dysentery (amebic)	96
Hookworm disease	495
Mumps	236
Puerperal septicemia	22
Rabies in animals	2
Trachoma	1
Whooping cough	1,706

June 1933

Botulism:
North Dakota | 1

Chicken pox:
Arkansas | 33
Connecticut | 602
District of Columbia | 15
Maine | 191
Nebraska | 140
North Dakota | 26
Vermont | 77
Wyoming | 29

Conjunctivitis, infectious:
Connecticut | 1

Dysentery (bacillary):
Connecticut | 1

German measles:	Cases
Connecticut	15
Maine	35

Lead poisoning:
Connecticut | 1

Lethargic encephalitis:
Connecticut | 1

Mumps:
Arkansas | 11
Connecticut | 252
Maine | 15
Nebraska | 73
North Dakota | 6
Vermont | 50
Wyoming | 3

Ophthalmia neonatorum:
Connecticut | 1

Paratyphoid fever:
Arkansas | 10
Maine | 3

Rabies in animals:
Connecticut | 18
Maine | 3

Rocky Mountain spotted fever:
District of Columbia | 3
Wyoming | 30

Septic sore throat:	Cases
Connecticut	9
Nebraska	1

Tetanus:
Connecticut | 2

Trachoma:
Arkansas | 2
Connecticut | 1

Tularaemia:
Wyoming | 2

Typhus fever:
Arkansas | 1

Undulant fever:
Arkansas | 5
Connecticut | 2
Maine | 2
Vermont | 1

Vincent's angina:
Maine | 3

Vincent's infection:
North Dakota | 16

Whooping cough:
Arkansas | 71
Connecticut | 242
District of Columbia | 48
Maine | 55
Nebraska | 168
North Dakota | 23
Vermont | 45
Wyoming | 25

WEEKLY REPORTS FROM CITIES

City reports for week ended July 1, 1933

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Maine:											
Portland	0		0	0	1	0	0	0	0	4	22
New Hampshire:											
Concord	0		0	0	0	0	0	0	0	0	15
Manchester											
Nashua	1		0		0	0	0	0	1	0	
Vermont:											
Barre	0		0	11	0	0	0	0	0	0	4
Burlington	0	0	0	0	0	0	0	0	0	0	10
Massachusetts:											
Boston	2		0	171	11	33	0	0	0	36	192
Fall River	0		0	0	2	3	0	0	0	4	23
Springfield	0		0	0	0	2	0	1	0	14	37
Worcester	0		0	65	5	18	0	3	0	1	40
Rhode Island:											
Pawtucket	0		0	0	0	1	0	0	0	0	12
Providence	0		0	0	3	9	0	3	0	19	60
Connecticut:											
Bridgeport	0		0	9	1	10	0	0	0	0	25
Hartford	0		0	2	2	6	0	1	0	0	33
New Haven	1		0	0	2	0	0	0	0	3	35
New York:											
Buffalo	1		0	69	20	19	0	3	0	44	133
New York	33	3	2	307	90	65	0	80	15	96	1,373
Rochester	0		0	0	3	11	0	3	0	18	61
Syracuse	1		0	0	3	4	0	1	0	11	46
New Jersey:											
Camden	0	1	0	1	1	5	0	1	0	0	14
Newark	0	1	0	29	5	11	0	5	0	43	83
Trenton	0	0	0	21	1	3	0	5	1	4	34
Pennsylvania:											
Philadelphia	1	1	1	227	12	44	0	14	1	20	406
Pittsburgh	6	1	1	7	8	33	0	6	1	100	164
Reading	1		0	3	1	2	0	1	0	5	24
Scranton	0	0	0	0	0	3	0	0	0	3	

City reports for week ended July 1, 1933—Continued

State and city	Diphtheria cases	Influenza Cases	Influenza Deaths	Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
Ohio:											
Cincinnati	1	0	0	7	7	6	0	5	1	9	151
Cleveland	9	14	0	1	9	31	0	13	1	53	198
Columbus	2	0	0	1	4	10	0	6	3	0	76
Toledo	3	----	0	23	1	30	0	4	0	23	65
Indiana:											
Fort Wayne	2	----	0	0	0	0	0	1	0	0	19
Indianapolis	0	----	0	34	4	0	0	5	1	7	----
South Bend	0	----	0	1	1	0	0	0	0	1	21
Terre Haute	0	----	0	13	0	2	0	0	0	2	19
Illinois:											
Chicago	0	2	1	135	21	91	0	45	2	72	616
Cicero	0	0	0	0	0	0	0	0	0	0	4
Springfield	0	----	0	0	1	0	0	0	2	2	30
Michigan:											
Detroit	12	0	0	55	2	24	0	14	4	158	245
Flint	0	----	0	0	2	6	0	0	0	1	19
Grand Rapids	0	----	0	2	2	4	0	0	0	4	25
Wisconsin:											
Kenosha	0	----	----	2	----	1	0	----	0	24	----
Madison	0	----	----	3	----	1	0	----	0	7	----
Milwaukee	0	----	0	3	1	15	0	7	0	111	72
Racine	0	----	0	0	0	7	0	0	0	24	17
Superior	0	----	0	0	0	0	0	0	0	3	11
Minnesota:											
Duluth	0	----	0	34	2	0	0	0	0	40	20
Minneapolis	5	----	0	3	3	9	0	5	0	8	103
St. Paul	0	----	0	7	3	4	0	3	0	65	61
Iowa:											
Des Moines	1	----	----	0	----	1	0	----	0	0	28
Sioux City	2	----	----	0	----	2	0	----	0	6	---
Waterloo	0	----	----	0	----	0	0	----	0	1	----
Missouri:											
Kansas City	4	0	0	1	6	3	0	5	1	5	108
St. Joseph	0	----	0	4	3	1	0	0	1	0	37
St. Louis	12	----	0	119	6	5	0	11	13	13	231
North Dakota:											
Fargo	0	----	0	2	1	2	0	0	0	0	9
Grand Forks	0	0	0	0	0	0	0	0	0	2	----
South Dakota:											
Aberdeen	1	----	0	0	0	0	0	0	0	0	----
Sioux Falls	0	----	0	1	0	0	0	0	0	0	6
Nebraska:											
Omaha	0	----	0	39	4	2	1	1	0	9	59
Kansas:											
Topeka	0	----	0	8	0	3	0	0	0	0	30
Wichita	0	----	0	0	4	3	0	1	1	5	46
Delaware:											
Wilmington	1	----	0	5	1	0	0	0	0	2	21
Maryland:											
Baltimore	0	0	0	0	9	29	0	9	0	61	185
Cumberland	0	----	0	0	0	1	0	0	0	0	10
Frederick	0	----	0	0	0	0	0	0	0	0	4
District of Columbia:											
Washington	3	0	0	43	7	7	0	9	0	26	121
Virginia:											
Lynchburg	0	----	0	31	0	1	0	2	0	12	15
Norfolk	0	----	0	0	3	2	0	1	2	10	----
Richmond	0	----	0	1	2	1	0	2	0	13	40
Roanoke	0	0	0	2	0	2	0	0	1	4	10
West Virginia:											
Charleston	0	----	0	0	0	0	0	0	0	5	12
Huntington	3	----	0	0	0	0	0	0	0	0	----
Wheeling	1	0	0	0	1	1	0	0	0	22	17
North Carolina:											
Raleigh	0	----	0	0	0	0	0	1	1	0	19
Wilmington	0	----	0	3	0	0	0	0	0	0	4
Winston-Salem	0	1	0	0	0	0	0	4	1	2	----
South Carolina:											
Charleston	0	----	0	0	0	0	0	1	2	9	20
Columbia	0	----	1	0	1	0	0	0	0	0	8
Greenville	2	----	0	1	0	0	0	1	0	2	9
Georgia:											
Atlanta	3	12	0	7	4	0	0	4	1	0	----
Brunswick	0	----	0	0	0	0	0	1	0	1	1
Savannah	0	3	0	0	0	0	0	2	1	6	36
Florida:											
Miami	0	----	0	0	0	1	0	1	0	7	19
Tampa	1	0	0	0	0	0	0	0	1	6	13

City reports for week ended July 1, 1933—Continued

State and city	Diphtheria cases	Influenza Cases	Influenza Deaths	Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
Kentucky:											
Ashland	0			0	0	0	0	0	----	1	12	----
Lexington	0			0	0	1	0	0	2	0	0	15
Louisville	5			1	5	3	0	2	1	9	60
Tennessee:											
Memphis	0			0	69	1	0	0	7	6	29	69
Nashville	0			0	4	1	2	0	2	1	7	43
Alabama:											
Birmingham	1			0	0	3	2	0	3	4	4	58
Mobile	0			0	0	0	0	0	0	0	0	16
Montgomery	0				0	----	0	0	0	0	0	
Arkansas:											
Fort Smith	0			0	----	0	0		0	2	----
Little Rock	0		0	14	2	0	0	1	0	0	3
Louisiana:											
New Orleans	3	2	1	1	6	2	0	16	0	1	150
Shreveport	0		0	3	0	0	0	2	1	0	37
Oklahoma:											
Oklahoma City	0	6		4	4	2	0	3	0	10	45
Tulsa	0			9	----	1	0		0	8	----
Texas:											
Dallas	7		0	2	0	5	1	3	2	12	69
Fort Worth	0		0	0	4	1	0	1	1	4	35
Galveston	0		0	3	3	0	0	0	0	1	20
Houston	3		0	0	4	0	0	6	0	0	69
San Antonio	0		0	5	5	0	0	13	0	0	89
Montana:											
Billings	0		0	0	0	0	0	0	0	0	5
Great Falls	0		0	0	0	0	0	0	0	0	6
Helena	0		0	0	0	1	0	0	1	0	5
Missoula	0		0	0	0	0	0	0	0	0	9
Idaho:											
Boise	0		0	1	0	0	0	0	0	3	5
Colorado:											
Denver	3		3	1	11	6	0	3	0	6	77
Pueblo	0		0	0	1	0	0	2	0	0	9
New Mexico:											
Albuquerque	0		0	0	0	1	0	1	1	11	7
Utah:											
Salt Lake City	0		0	37	0	4	0	1	0	30	18
Nevada:											
Reno	0		0	0	0	0	0	0	0	0	5
Washington:											
Seattle	3			5	----	1	0		0	8	----
Spokane	0			41	----	0	0		0	0	----
Tacoma	0		0	1	0	1	0	0	0	0	17
Oregon:											
Portland	0		0	1	0	8	10	0	0	1	55
Salem	0		0	0	0	0	0	0	0	0	----
California:											
Los Angeles	23	4	1	119	11	25	6	15	0	74	256
Sacramento	0		0	0	0	0	0	1	2	8	16
San Francisco	2	2	0	3	6	0	0	9	0	23	125

State and city	Meningococcus meningitis Cases	Meningococcus meningitis Deaths	Poliomyelitis cases	State and city	Meningococcus meningitis Cases	Meningococcus meningitis Deaths	Poliomyelitis cases
Massachusetts:				Michigan:			
Boston	1	0	3	Flint	1	0	0
Connecticut:				Iowa:			
Hartford	0	0	1	Des Moines	0	0	1
New York:				Missouri:			
New York	2	1	5	St. Louis	0	1	0
Pennsylvania:				Kentucky:			
Pittsburgh	1	1	1	Louisville	1	1	0
Ohio:				Tennessee:			
Columbus	0	0	1	Memphis	1	0	0
Indiana:				Oregon:			
Indianapolis	2	0	0	Portland	0	1	0
Illinois:				California:			
Chicago	6	5	0	San Francisco	0	0	1

Lethargic encephalitis.—Cases: New York, 1; Pittsburgh, 1; Detroit, 1; Birmingham, 1; New Orleans, 1
Pellagra.—Cases: Philadelphia, 1; Charleston, S.C., 3; Atlanta, 1; Birmingham, 8; Montgomery, 1; Shreveport, 1.
Typhus fever.—Cases: Baltimore, 1; Charleston, S.C., 1; Savannah, 3; New Orleans, 1. Deaths: New Orleans, 1.

FOREIGN AND INSULAR

CANADA

Quebec Province—Communicable diseases—Ten weeks ended May 6, 1933.—The Bureau of Health of the Province of Quebec, Canada, reports cases of certain communicable diseases for the 10 weeks ended May 6, 1933, as follows:

Disease	2 weeks ended—				
	Mar. 11	Mar. 25	Apr. 8	Apr. 22	May 6
Cerebrospinal meningitis	2	1	1	3	
Chicken pox	428	243	465	488	273
Diphtheria	47	43	45	42	27
Erysipelas	13	21	28	21	16
German measles	5	21	8	6	53
Influenza	14	6	6	12	5
Measles	385	161	316	387	335
Ophthalmia neonatorum		1		2	
Poliomyelitis	2	1	1	4	2
Puerperal septicemia	1	4	1		2
Scarlet fever	179	122	93	132	144
Tuberculosis	133	153	156	99	139
Typhoid fever	24	25	29	19	32
Undulant fever			1	1	
Whooping cough	345	234	183	106	107
Other communicable diseases	220	180	188	141	146

ITALY

Communicable diseases—Four weeks ended March 5, 1933.—During the 4 weeks ended March 5, 1933, cases of certain communicable diseases were reported in Italy as follows:

Disease	Feb. 6–12		Feb. 13–19		Feb. 20–26		Feb. 27–Mar. 5	
	Cases	Communes affected	Cases	Communes affected	Cases	Communes affected	Cases	Communes affected
Anthrax	28	23	12	11	3	3	12	12
Cerebrospinal meningitis	11	9	16	10	13	12	22	19
Chicken pox	449	133	355	103	452	118	357	114
Diphtheria and croup	574	287	663	363	701	318	643	318
Dysentery			1	1	5	5		
Lethargic encephalitis	2	2	4	4			4	4
Measles	1,708	213	1,430	214	1,792	239	1,585	209
Poliomyelitis	3	3	4	4	2	2		
Scarlet fever	355	111	352	135	394	121	341	127
Typhoid fever	256	151	206	128	207	131	181	126

VENEZUELA

Vital statistics—Year 1932.—The following figures, showing births and deaths in Venezuela during the year 1932, have been published by the Ministerio de Salubridad y de Agricultura y Cria of Venezuela

		Deaths from—Continued	
Estimated population	3,100,278	Malaria	5,318
Number of births	89,961	Measles	119
Birth rate per 1,000 population	29.0	Meningitis	265
Number of deaths	54,040	Nephritis and Bright's disease	670
Death rate per 1,000 population	17.4	Pneumonia and broncho-pneumonia	1,674
Deaths from—		Poliomyelitis	15
Bronchitis	610	Puerperal fever and septicemia	170
Cancer and other malignant tumors	570	Scarlet fever	10
Diabetes	78	Syphilis	400
Diarrhea and enteritis (under 2 years)	2,527	Tetanus, infantile	871
Diphtheria and croup	56	Tuberculosis, pulmonary	3,144
Dysentery	930	Tuberculosis, other forms	375
Erysipelas	51	Typhoid fever	433
Heart disease	1,854	Whooping cough	260
Leprosy	46		

YUGOSLAVIA

Communicable diseases—May 1933.—During the month of May 1933, certain communicable diseases were reported in Yugoslavia as follows:

Disease	Cases	Deaths	Disease	Cases	Deaths
Anthrax	28	5	Poliomyelitis	2	1
Cerebrospinal meningitis	14	1	Scarlet fever	216	12
Diphtheria and croup	496	42	Sepsis	6	1
Dysentery	40	1	Tetanus	41	14
Erysipelas	141	3	Typhoid fever	158	16
Measles	836	15	Typhus fever	62	7
Paratyphoid fever	7				

CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER. AND YELLOW FEVER

(NOTE.—A table giving current information of the world prevalence of quarantinable diseases appeared in the PUBLIC HEALTH REPORTS for June 30, 1933, pp. 776–786. A similar cumulative table will appear in the PUBLIC HEALTH REPORTS to be issued July 28, 1933, and thereafter, at least for the time being, in the issue published on the last Friday of each month.)

Cholera

China.—During the week ended July 8, 1933, 2 cases of cholera were reported in Tientsin, China.

Philippine Islands.—During the week ended July 8, 1933, cholera was reported in the Philippine Islands as follows: Cebu Province, Opon, 6 cases, 2 deaths; Occidental Negros Province, San Carlos, 1 case, 1 death.

Plague

India.—During the week ended July 1, 1933, 1 case of plague with 1 death was reported in Bassein, India.

Iraq.—During the week ended July 1, 1933, 3 cases of plague were reported in Baghdad, Iraq.

Typhus Fever

Egypt.—During the week ended July 1, 1933, 9 cases of typhus fever with 3 deaths were reported in Alexandria, Egypt. During the week ended June 24, 1933, Cairo, Egypt, reported 6 cases of typhus fever with 3 deaths from the same cause.

Syria.—Under date of May 4, 1933, an epidemic of typhus fever was reported in Syria, in the Deir-el-Zor district.